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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/616,748	07/09/2003	Gary A. Brist	42P12136D	2763

7590 06/03/2005

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EXAMINER	
ANYA, IGWE U	

ART UNIT	PAPER NUMBER
2891	

DATE MAILED: 06/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/616,748	BRIST ET AL.	
	Examiner	Art Unit	
	Igwe U. Anya	2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 February 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *17-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *17-21,23,24 and 26* is/are rejected.

7)☐ Claim(s) *22 and 25* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *09 July 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☒ Other: *See Continuation Sheet*.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 17 – 19, 21 and 23 are rejected under 35 U.S.C. 102(b) as being anticipated by Mayer et al. (US Patent 5246108).

3. Mayer et al. teach an apparatus, comprising an electrically conductive trace (20) on a substrate, the electrically conductive trace includes first (17) and second (16) materials, the electrically conductive trace formed by applying a laser energy (18) to a selected area of a first layer of the first material disposed on a second layer of the second material. The laser energy penetrates the first material into the second material to melt and inter-diffuse the first and second materials in response to the applied energy (col. 5 lines 7 – 30);

wherein the substrate is part of one of a semiconductor package, a printed circuit board, and a die (fig. 2C);

wherein the second layer includes copper (col. 4 lines 38 – 41); and

wherein the electrically conductive trace is between about 10 microns and about 20 microns in thickness (col. 4 lines 38 – 55) and between about 27 microns and about 35 microns in width (col. 5 lines 27 – 49, & fig. 2D).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 20, 24 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mayer et al. (US Patent 5264108) in view of Saka et al. (JP 2000021546).

7. Mayer et al. teach the features previously outlined, but lack wherein the first material includes tin as a conversion coating material.

8. However, Saka et al. teach irradiating a second material made or copper (1) by penetrating a laser beam (fig 4) through a first material made of tin (2) to inter-diffuse the tin and copper to form a copper alloy (2a) having a higher hardness.

9. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teachings of Saka et al. into the Mayer et al. to achieve a conductive trace with a higher hardness.

10. Claims 22 and 25 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Remarks

11. Applicant's arguments filed on February 22, 2005 have been fully considered but they are not persuasive. Mayer et al. teach a laser beam (18), penetrating layer 17 to layer 16, melting layer 16 and inter-diffusing layers 17 and 16 to form an alloy (col. 5 lines 15 – 19 & figs. 2B, 2C). Applicant's argument regarding the Mori et al. reference is rendered moot by applicant's amendment. However, Mori et al. disclose the radiation can be practiced with a laser (col. 25 lines 53 – 56). Furthermore, for inter-diffusion to occur the materials must be in contact with each other.

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

13. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Contact Information

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Igwe U. Anya whose telephone number is (571) 272-1887. The examiner can normally be reached on M - F 8:30am - 5:00pm.

15. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William B. Baumeister can be reached on (571) 272-1722. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

16. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Igwe U. Anya
Examiner
Art Unit 2891

IA
May 4, 2005

B. WILLIAM BAUMEISTER
SUPERVISORY PATENT EXAMINER

Continuation of Attachment(s) 6). Other: English machine translation of JP 2000-021546 .

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-021546

(43)Date of publication of application : 21.01.2000

(51)Int.Cl. H01R 43/16

(21)Application number : 10-184173

(22)Date of filing : 30.06.1998

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SUMITOMO WIRING SYST LTD
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SHIOTANI JUN
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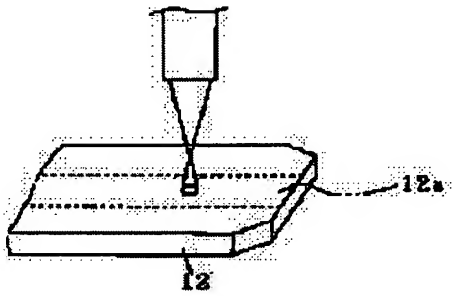
(54) MANUFACTURE OF FITTING CONNECTING TERMINAL

(57)Abstract:

PROBLEM TO BE SOLVED: To form an alloy layer having hardness higher than tin only in the sliding contact part at fitting time with a mating side connecting terminal by irradiating a laser beam in a focus dislocated state to the surface of the sliding contact part at fitting time with the mating side connecting terminal among a copper base material forming a tin plating layer.

SOLUTION: A laser beam is irradiated to the sliding contact part 12a of a tab 12 of a male terminal forming tin plating on the plate-like strip material surface of copper or a copper alloy in a state of dislocating a focus from the surface of the sliding contact part 12a, and the laser beam is irradiated at plural places along the belt-like sliding contact part 12a. In dislocating the focus of the laser beam, the focus is dislocated upward in the direction orthogonal to the surface from the surface of the sliding contact part 12a or is dislocated downward. A focus dislocating distance of the laser beam is properly changed by a thickness of a copper base material and tin plating, but is desirably dislocated by about 1 mm to 2 mm. Thus, the tin plating layer is alloyed with copper in the vicinity of an interface with the copper base material to form a tin copper alloy layer having hardness higher than tin.



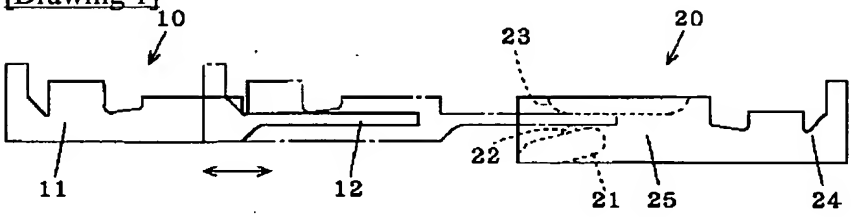
* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

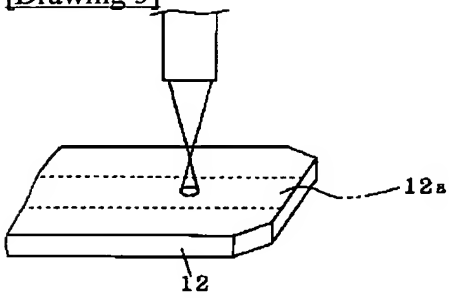
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

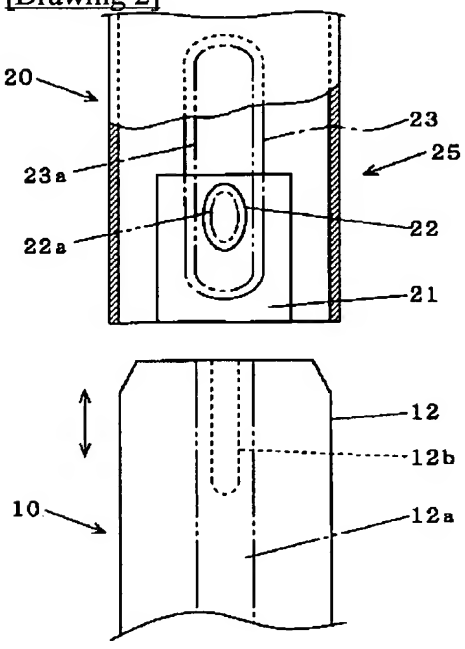
[Drawing 1]



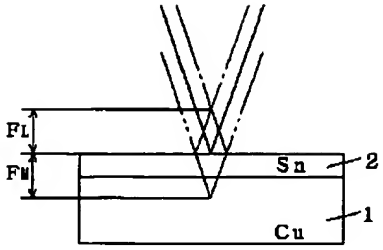
[Drawing 3]



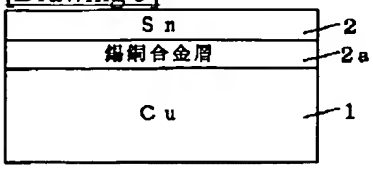
[Drawing 2]



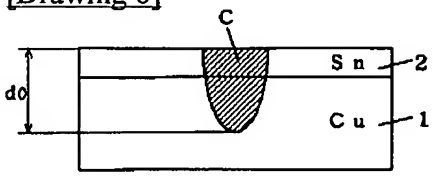
[Drawing 4]



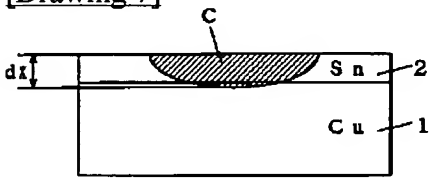
[Drawing 5]



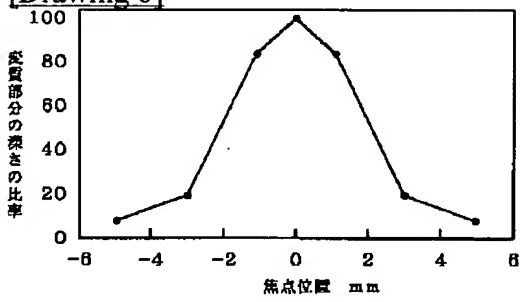
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacture approach of the fitting mold connection terminal used for electric wiring, such as an automobile and an industrial device.
[0002]
[Background of the Invention] Before, generally tinning has been performed to the fitting mold connection terminal used for connection of electric wires in electric wiring, such as an automobile and an industrial device. This aims at being stabilized and obtaining low contact resistance by destroying the scaling coat of tinning by friction and carrying out adhesion of the fresh tin at the time of connection of a terminal.
[0003] Moreover, it was used for the connection terminal especially at the electric wiring used for important signal circuits, such as ABS (anti-lock brake system) of an automobile, and an air bag, having plated with gold.
[0004] The adhesion of the above-mentioned tinning originates in a thing with the low (Vickers hardness 40-80) degree of hardness of tin. However, that the degree of hardness of tin is low causes the problem of raising the insertion force at the time of connection. That is, in order for adhesion wear of tinning to occur at the time of fitting connection of a terminal and to carry out fitting against the deformation resistance of tin, the insertion force will go up.
[0005] By the way, in electric wiring, such as an automobile, it is common to connect the bundle (for "wire harness" to be called hereafter) of two or more electric wires by one connector, and the force required for connection of a connector can be estimated as a value which multiplied the insertion force per terminal by the number (it is generally ten poles - 20 pole conventionally) of an electric wire. Therefore, if the insertion force per terminal is high, the force required for connection of a connector will serve as a big value according to the number of electric wires of wire harness.
[0006] Especially remarkable advance and development of car electronics in recent years made the electronic equipment carried in an automobile, and the number of CPUs increase by leaps and bounds, the electric-wire number of wire harness increased in connection with it, and the request that he wants to attain multipolarization (30 poles - 40 pole) of a connector has also become strong.
[0007] However, if a connector is multipolarized like ****, the force required for connection of the connector concerned will also go up in proportion to an electric-wire number, and connection of a connector becomes impossible without auxiliary devices, such as a bolt and a lever. For this reason, even if it miniaturizes a terminal, an auxiliary device will check a miniaturization and lightweight-ization of a connector.
[0008] Although it is possible to reduce contact pressure (forcing force given to a contact in the fitting section) in order to reduce the insertion force of a terminal, the stable low contact resistance is no longer obtained in this case. If it puts in another way, since it is difficult to reduce the insertion force of a terminal, with the stable contact resistance maintained, in case a connector is multipolarized, an auxiliary device becomes indispensable, and it has become the factor which checks a miniaturization and lightweight-ization of a connector.
[0009] In addition, if gilding is used for a connection terminal, since low contact resistance is stabilized and is obtained also with low contact pressure, even if it can make the insertion force of a terminal low

and multipolarizes a connector, the force which the connection takes will not go up remarkably, but gilding is not suitable for especially the multipolar connector in order to require dozens times [several times to] as many cost as this as compared with tinning.
[0010] Then, a tinning layer is formed in the front face of the copper base material which forms a connection terminal, and the connection terminal which performed heat treatment to this for 1 to 3 hours under 150-degree-C or more temperature condition 170 degrees C or less is proposed.
[0011] With such a connection terminal, it has structure to which the part near the interface with a copper base material was changed into five layers of intermetallic-compound Cu6Sn among tinning layers, and the tinning layer of predetermined thickness remained in the front face.
[0012] In this case, since the degree of hardness of intermetallic-compound Cu6Sn5 is higher than the degree of hardness of tin, the degree of hardness over which the connection terminal itself is covered also becomes high, and it becomes possible to reduce the insertion force at the time of fitting connection of a connection terminal of it. Moreover, since the tinning layer remains in the copper base material front face, it is also possible for it to be stabilized and to obtain low contact resistance at the time of connection of a terminal.
[0013] In addition, invention concerning Japanese Patent Application No. No. 110898 [nine to] for which the applicant for this patent applied previously as a technique relevant to this is mentioned.
[0014]
[Problem(s) to be Solved by the Invention] However, with the above connection terminals, it has the composition that covered the whole front face and five layers of intermetallic-compound Cu6Sn were formed.
[0015] Since the tinning layer is thin also in the sticking-by-pressure connection when it follows, for example, the connection terminal is equipped with the sticking-by-pressure connection with other electric wires, there is a problem that the gas-tight structure between a sticking-by-pressure connection and an electric wire is inadequate, and the contact resistance low and stabilized among them is not obtained. Moreover, since five layers of intermetallic-compound Cu6Sn have the hard and weak property, it also has the problem that a crack arises in a sticking-by-pressure connection at the time of sticking by pressure to an electric wire.
[0016] Then, this invention is made in view of the above-mentioned technical problem, and aims at offering the manufacture approach of the fitting mold connection terminal which can form an alloy layer with a degree of hardness higher than tin only into the slide contact part at the time of fitting with the connection terminal of the other party among fitting mold connection terminals.
[0017]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, invention of claim 1 The plating process which forms a tinning layer in the front face of the copper base material which is the manufacture approach of a fitting mold connection terminal of acquiring electric contact, and forms said connection terminal by fitting with the connection terminal of the other party, Among said copper base materials with which said tinning layer was formed, where a focus is shifted from the slide contact partial front face into the slide contact part at the time of fitting with the connection terminal of the other party, a laser beam is irradiated. The laser beam exposure process which forms a tin-copper alloy layer with a degree of hardness higher than tin near the interface with said copper base material among said tinning layers in said slide contact part is included.
[0018] In addition, it is [like] good in this case according to claim 2 to shift the focus of a laser beam from a slide contact partial front face 1mm - 2mm to a top or down.
[0019]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail, referring to a drawing.
[0020] <the gestalt of A. fitting mold connection terminal> -- the fitting mold connection terminal first manufactured by the manufacture approach concerning this invention is explained.
[0021] Drawing 1 is the side elevation showing the male terminal 10 which is a fitting mold connection terminal, and a receptacle 20, respectively, and these have the composition of acquiring electric contact, by fitting in each other with the terminal 20 of the other party, or 10. moreover, drawing 2 -- a part of connection parts of these male terminal 10 and a receptacle 20 -- it is a notching top view.
[0022] The male terminal 10 is equipped with the wire barrel 11 which is the sticking-by-pressure part

which performs sticking by pressure with an electric wire, and the tab 12 which is a fitting part with a receptacle 20. A tab 12 is formed in plate-like and the smooth field is made to the top face and inferior surface of tongue, respectively.

[0023] A receptacle 20 is equipped with the wire barrel 24 which is the sticking-by-pressure part which performs sticking by pressure with an electric wire, and the fitting section 25 which is a fitting part with the male terminal 10. The fitting section 25 has the shape of a cube type in the air, and equips the interior with a tongue-shaped piece 21, embossing 22, and a bead 23. in addition, drawing 2 showed the interior of the fitting section 25 -- it is a notching top view a part.

[0024] Embossing 22 is the convex member prepared in the upper part of a tongue-shaped piece 21, and carries out point contact to the inferior surface of tongue of a tab 12 at the time of fitting with the male terminal 10. The tongue-shaped piece 21 has the function as a spring on which the pressure which forces contact pressure 22, i.e., embossing, on a tab 12 is made to act. Moreover, a bead 23 is also a convex member, the top face of a tab 12 is contacted and the embossing 22 concerned receives the contact pressure exerted on a tab 12.

[0025] A tab 12 is inserted in the gap of embossing 22 and a bead 23 in case fitting of the male terminal 10 is carried out to a receptacle 20. While a bead 23 ****s on the top face of a tab 12 at this time, embossing 22 ****s on the inferior surface of tongue of a tab 12. And if a tab 12 is completely inserted into the fitting section 25, after a bead 23 and embossing 22 have contacted the tab 12, respectively, pressure-welding maintenance of the tab 12 is carried out among them, and it has the composition that the electrical installation between the male terminal 10 and a receptacle 20 is made by this.

[0026] Thus, the band-like part to which fitting met being made among the top faces of the tab 12 about the male terminal 10 side at the longitudinal direction of the crosswise center section on the occasion is slide contact partial 12a (part surrounded by the two-dot chain line of drawing 2) with a bead 23, and the band-like part which met the longitudinal direction of the crosswise center section among the inferior surfaces of tongue of a tab 12 has become slide contact partial 12b (part surrounded by the dotted line of drawing 2) with embossing 22. On the other hand, about the receptacle 20 side, the top part of the embossing 22 is slide contact partial 22a (part surrounded by the two-dot chain line of the embossing 22 of drawing 2) with slide contact partial 12b of a tab 12, and the band-like part in alignment with the longitudinal direction of the convex of a bead 23 has become slide contact partial 23a (part surrounded by the two-dot chain line of the bead 23 of drawing 2) with slide contact partial 12a of a tab 12.

[0027] The <manufacture approach of B. fitting mold connection terminal>, next the manufacture approach of a fitting mold connection terminal are explained. After the male terminal 10 or receptacle 20 which is this fitting mold connection terminal performs tinning processing to tabular ** material first, the front stirrup which processes that ** material into the above-mentioned gestalt is manufactured by irradiating a laser beam behind at that predetermined part.

[0028] With a <B-1. tinning process> book operation gestalt, copper or a copper alloy is used as a base material of a fitting mold connection terminal. In the fitting mold connection terminal which this requires for this invention, copper or a copper alloy is for being easy to form tin and an intermetallic compound.

[0029] First, in order to raise the adhesion of a tinning layer, the line of the ****** material front face of copper or a copper alloy, removal of an oxide film, etc. are pretreated. And next, tinning processing is performed to the front face of ** material, and a tinning layer is formed in it. In addition, a tinning layer is formed all over the front face of both sides of ** material. As for the thickness of the tinning layer at this time, it is desirable to be more preferably 0.5-micrometer or more referred to as 0.8 micrometers or more 1.2 micrometers or less that what is necessary is just 2.0 micrometers or less.

[0030] About the male terminal 10, it forms in the gestalt as processed ** material and shown in drawing 1 and drawing 2 after tinning processing.

[0031] Although it is processed into the punch die which pierced ** material and developed the receptacle 20 concerned about the receptacle 20 on the other hand, in the gestalt of a receptacle 20 shown in drawing 1 and drawing 2 , it sets without assembling. This is because the laser beam later mentioned to embossing 22 and the bead 23 of the interior cannot be irradiated if a receptacle 20 is assembled in the gestalt shown in drawing 1 and drawing 2 .

[0032] However, the part equivalent to embossing 22 and a bead 23 is formed in convex by press

working of sheet metal etc. After irradiating a laser beam so that it may mention later, it is because processing of these parts becomes difficult.

[0033] A laser beam is irradiated to a <B-2. laser beam exposure process> next the above-mentioned male terminal 10, and the receptacle 20 of a half-processing condition.

[0034] Drawing 3 is drawing showing the condition of irradiating the laser beam at slide contact partial 12a of the tab 12 of the male terminal 10. At this laser beam exposure process, where a focus is shifted from a slide contact partial 12a front face, that laser beam is irradiated, and the exposure of this laser beam is performed along with band-like slide contact partial 12a at two or more places. In order to shift the focus of a laser beam, as shown in drawing 4 , the focus may be floor line ** carried out upwards along the direction which intersects perpendicularly with the front face from a slide contact partial 12a front face, or you may FM ** carry out caudad (location shown with the two-dot chain line of drawing 4 R> 4). (location shown with the alternate long and short dash line of drawing 4)

[0035] Under the present circumstances, although the distance which sets the output of a laser beam to two or more [190J //mm], sets that irradiation time to 5 - 10ms as energy per unit area of a spot, and shifts the focus of a laser beam from a slide contact partial 12a front face is suitably changed with a copper base material, the thickness of tinning, etc., it is desirable to shift 1mm - about 2mm to a top or down along the direction which intersects perpendicularly with that front face to a slide contact partial 12a front face.

[0036] If heat-treatment is performed to the copper base material which performed tinning under 150-160-degree C temperature conditions for 1 to 3 hours, it will be as stated above to be alloyed near the interface with a copper base material among the tinning layer by five layers of intermetallic-compound Cu6Sn. However, as by irradiating the laser beam beyond a fixed output showed to the copper base material which performed tinning at drawing 5 , the tinning layer 2 alloyed the invention-in-this-application person etc. with copper near the interface with the copper base material 1, and he checked that a degree of hardness could form high tin-copper alloy layer 2a there rather than tin. In addition, what this tin-copper alloy layer 2a will be Cu6Sn5 intermetallic compound is checked. Then, it was made to make the tinning layer 2 alloy near the interface with the copper base material 1 in these slide contact partial 12a by irradiating a laser beam also at slide contact partial 12a of this male terminal 10.

[0037] By the way, in case a laser beam is irradiated as mentioned above, the reason for shifting the focus of the laser beam from a slide contact partial 12a front face is as follows.

[0038] Namely, as shown in the continuous-line location of drawing 4 , when the laser beam concerned is irradiated in the condition (floor line=FM) of having made the focus of a laser beam in agreement with the front face of slide contact partial 12a, the affected zone part C (shadow area of drawing 6) according to the laser beam since the energy distribution of a laser beam becomes high in the center section on the property of light, as the core of the part which irradiated the laser beam serves as an elevated temperature too much and it is shown in drawing 6 -- the interior of the tinning layer 2 to the copper base material 1 -- it will be deeply alike and will reach until. In this case, it will have a bad influence on the spring nature of the copper base material 1 etc.

[0039] here -- said affected zone part C -- the interior of the copper base material 1 -- if the output of a laser beam is made small, it will become impossible to form tin-copper alloy layer 2a, although making the output of a laser beam small is also considered in order to prevent it being alike deep and reaching until

[0040] then -- as shown in the alternate long and short dash line location or two-dot chain line location of drawing 4 , while maintaining the output of a laser beam beyond a fixed output required for formation of tin-copper alloy layer 2a -- the focus of the laser beam -- the upper part from the front face of the slide contact part 12 -- or he shifts below and is trying to irradiate By this, as shown in drawing 7 R> 7, it will apply to the part near the interface of the tinning layer 2 and copper base material 1 from the tinning layer 2, a shallow and large part will be covered, and the affected zone part C (shadow area of drawing 7) will arise. And in this affected zone part C, the tinning layer 2 is alloyed by tin-copper alloy layer 2a near the boundary with the copper base material 1. Therefore, it becomes possible to form tin-copper alloy layer 2a, preventing the bad influence to the copper base material 1.

[0041] In addition, when the focus was shifted on the irradiated object which performed tinning processing on the surface of the copper alloy and the laser beam was actually irradiated, the result as shown in drawing 8 was obtained. In addition, the axis of abscissa of drawing 8 R> 8 shows the vertical

location of the focus which makes the front face of an irradiated object criteria (F0=0), and the axis of ordinate shows the ratio (%) of the depth dx (refer to drawing 7) of the affected zone part C to the depth d0 (refer to drawing 6) of the affected zone part C at the time of making the focus of a laser beam in agreement with the front face of an irradiated object.

[0042] As shown in this drawing, it turns out that the depth dx of the affected zone part C at the time of shifting a focus to the upper part or a lower part 3mm from an irradiated body surface is about 20% as compared with the depth d0 at the time of making a focus in agreement with an irradiated body surface, and the affected zone part C concerned becomes shallow.

[0043] Such a laser beam is irradiated and a degree of hardness forms high tin-copper alloy layer 2a rather than tin near the interface with a copper base material among the tinning layers 2 in each slide contact part 12a, 12b, 22a, and 23a similarly about the slide contact parts 12a and 12b of the tab 12 of the male terminal 10, and the slide contact parts 22a and 23a of a receptacle 20. And about a receptacle 20, crookedness processing is carried out at the gestalt shown in drawing 1 and drawing 2 .

[0044] Thus, the male terminal 10 and a receptacle 20 are manufactured.

[0045] Thus, in those slide contact parts 12a, 12b, 22a, and 23a, when tin-copper alloy layer 2a with a degree of hardness higher than tin is formed near the interface with the copper base material 1 among the tinning layers 2 in each slide contact parts 12a, 12b, 22a, and 23a, since an apparent degree of hardness becomes high, reduction of the insertion force at the time of carrying out fitting of the male terminal 10 and the receptacle 20 mutually can be aimed at. Moreover, since the tinning layer 2 remains on tin-copper alloy layer 2a formed in those slide contact parts 12a, 12b, 22a, and 23a, the value stabilized small as contact resistance between the male terminal 10 and a receptacle 20 can be acquired.

[0046] According to the manufacture approach of the connection terminals 10 and 20 applied to this invention as mentioned above Since the laser beam is mutually irradiated among the copper base materials 1 with which the tinning layer 2 was formed where a focus is shifted from the slide contact partial 12a front face into the slide contact parts 12a, 12b, 22a, and 23a at the time of fitting with the terminals 10 and 20 of the other party, It enables a degree of hardness to alloy the tinning layer 2 to high tin-copper alloy layer 2a rather than tin in the part near the boundary with the copper base material 1 only in the slide contact parts 12a, 12b, 22a, and 23a except for the wire barrels 11 and 24 which is sticking-by-pressure parts with an electric wire.

[0047] contact resistance with those electric wires does not become large superfluously, and a crack seems therefore, not to be generated into these wire barrel 11 and 24 parts, even if it sticks an electric wire to the wire barrels 11 and 24 which is that it is stabilized and contact resistance between them can be made small, simultaneously the sticking-by-pressure part of the connection terminals 10 and 20 by pressure, aiming at reduction of the insertion force at the time of fitting in the connection terminals 10 and 20

[0048] Moreover, the above-mentioned processing can be performed, preventing that the thermal effect by the laser beam etc. attains to a copper base material, since the laser beam is irradiated where a focus is shifted from those front faces into the slide contact parts 12a, 12b, 22a, and 23a.

[0049] In addition, what formed the copper-plating layer on the copper alloy containing zinc etc. as a copper base material may be used. In this case, when the amount of [by the laser beam] affected zone attains to even an internal copper alloy, the zinc of that copper alloy etc. will be mixed with a tin-copper alloy. However, there is an advantage of it becoming possible to make only a copper-plating layer and the tinning layer on it alloying, and becoming possible to form the good tin-copper alloy layer with which zinc etc. is not mixed, by irradiating a laser beam as mentioned above, where a focus is shifted from the slide contact parts 12a, 12b, and 22a and 23a front face.

[0050]

[Effect of the Invention] According to claim 1 of this invention, and the manufacture approach of a fitting mold connection terminal given in two, as mentioned above Since the laser beam is irradiated among the copper base materials with which the tinning layer was formed where a focus is shifted from the slide contact partial front face into the slide contact part at the time of fitting with the connection terminal of the other party, It becomes possible to form an alloy layer with a degree of hardness higher than tin in the near part with a copper base material among tinning layers in the slide contact part.

[0051] The above-mentioned processing can be performed preventing that the thermal effect by the laser beam etc. attains to a copper base material, since the laser beam is irradiated where a focus is especially

shifted from a slide contact partial front face.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The plating process which forms a tinning layer in the front face of the copper base material which is the manufacture approach of a fitting mold connection terminal of acquiring electric contact, and forms said connection terminal by fitting with the connection terminal of the other party, Among said copper base materials with which said tinning layer was formed, where a focus is shifted from the slide contact partial front face into the slide contact part at the time of fitting with the connection terminal of the other party, a laser beam is irradiated. The manufacture approach of a fitting mold connection terminal including the laser beam exposure process which forms a tin-copper alloy layer with a degree of hardness higher than tin near the interface with said copper base material among said tinning layers in said slide contact part.
[Claim 2] The manufacture approach of the fitting mold connection terminal according to claim 1 which shifts the focus of said laser beam from said slide contact partial front face 1mm - 2mm to a top or down.

[Translation done.]